Space Weather Technical Forecast

Issued on Tuesday, 15 February 2022 at 12:55 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Minor R1 Radio Blackouts. Active electron fluence throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the past 24 hours, with an M1.0 flare observed at 14/1731UTC from the largest and most magnetically complex region currently on the visible disc, AR2941, which is near the western limb. This was a long duration event, although there is currently no evidence of a Coronal Mass Ejection (CME) associated with this event. Given its location any CME would unlikely be Earth-directed. There are currently five numbered sunspots on the visible, the largest is the aforementioned AR2941, which is classified as a Eki/Beta-Gamma configuration, although given its location, its becoming difficult to assess its classification due to the foreshortening effect. AR2943 continued to develop after emerging from plage, and produced a C4 flare at 15/0518UTC. The remaining sunspots are all fairly small and simple magnetically. A new unnumbered and simple Axx sunspot recently emerged to the west of AR2947, although no further development were observed. No CMEs were in evidence in available coronagraph imagery in the 24 hours.

Solar Wind / Geomagnetic Activity: Earth is currently undergoing a gradual exit from a high speed stream (HSS) from coronal hole 53, with the solar wind speed, as measured by DSCOVR at L1, falling from slightly elevated levels, at 480km/s, to near background levels, currently near 400km/s. The solar wind density also showed a slight decline, from around 10ppcc at peak, finally falling to single figures. The IMF was small in scale, peaking at just 5nT, while the north-south component ranged from +3 to -4nT. The phi angle, meanwhile was predominantly negative (towards the sun).The net result of the above solar wind measures was Quiet (Kp1-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at Background levels.

The high energy electron flux (greater than 2MeV) ranged from Moderate to High levels, peaking at 5480pfu at 14/1835UTC. The corresponding 24-hour integrated electron fluence was above the 1e8 Active level throughout, with a rising trend observed, that finished the period at 14/2359UTC with 2.31e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to carry a daily Chance (30%) of M-class flares - these most likely from AR2941 until day 2 (16 Feb), at which point this risk should fall, with activity becoming Low or Very Low throughout the remainder of the forecast period.

Solar Wind / Geomagnetic Activity: No CMEs feature in this forecast period. The recent high speed stream from coronal hole 53 is considered to have peaked, meaning that geomagnetic activity is likely to remain Quiet throughout the period.

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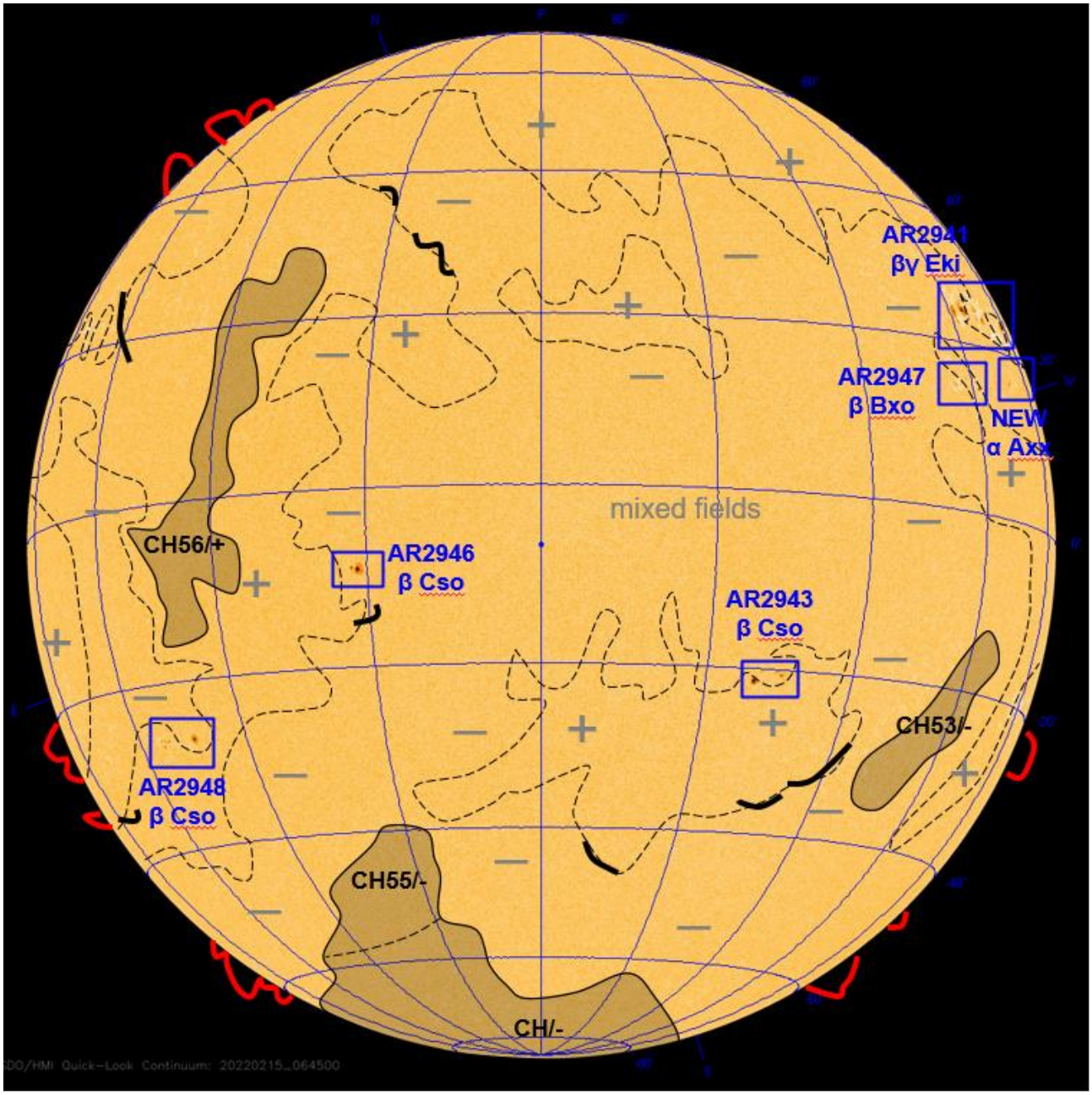
Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at Background levels, but with a daily Slight Chance of S1, mainly up to day 2 (16 Feb) while AR2941 remains near the western limb.

The high energy electron flux is expected to continue in its current mainly High flux diurnal oscillation - in the absence of any further drivers of increased geomagnetism. Active (1e8 integrated pfu) electron fluence levels are expected each day, perhaps with a slight waning trend as the ambient environment proves less supportive of maintaining current levels with time.

Figure 1. Solar Analysis Valid 15/0645UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in this forecast at present, however confidence in this is somewhat lower than usual given numerous (particularly westward-directed) CMEs observed around the very end of the last week.

The only coronal hole in the forecast is the current geoeffective CH53, which is considered to have peaked, with a ongoing gradual exit during day 1 (15 Feb) with solar winds declining to near background levels. Geomagnetic activity is expected to be mostly Quiet throughout the four day period. This forecast is reflected in both persistence, the appearance of the current disc (i.e. the absence of notable central coronal holes) and also unremarkable recent STEREO A measurements.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Radio Blackouts - X-Ray Flares:

The balance of sunspot groups should enter a state of flux over the forecast period. Returning regions Ex-2935 and Ex-2934 should begin to rotate onto the visible disc, with both appearing on far-side soundings and EUV imagery. This is in contrast to the depopulation expected to occur of the current western limb. This is all happening in the context of a changing disc, with flaring being observed from sources beyond the west limb as well as AR2941.

The X-ray forecast on balance starts with a daily Chance of M-class flares, reducing to a Slight Chance after midweek, however this may be revised further downwards should the eastern horizon spots fall short of expectations as the western limb quietens down.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	30	30	20	5
Very Active	R3 to R5 X Class	No	2	2	2	1

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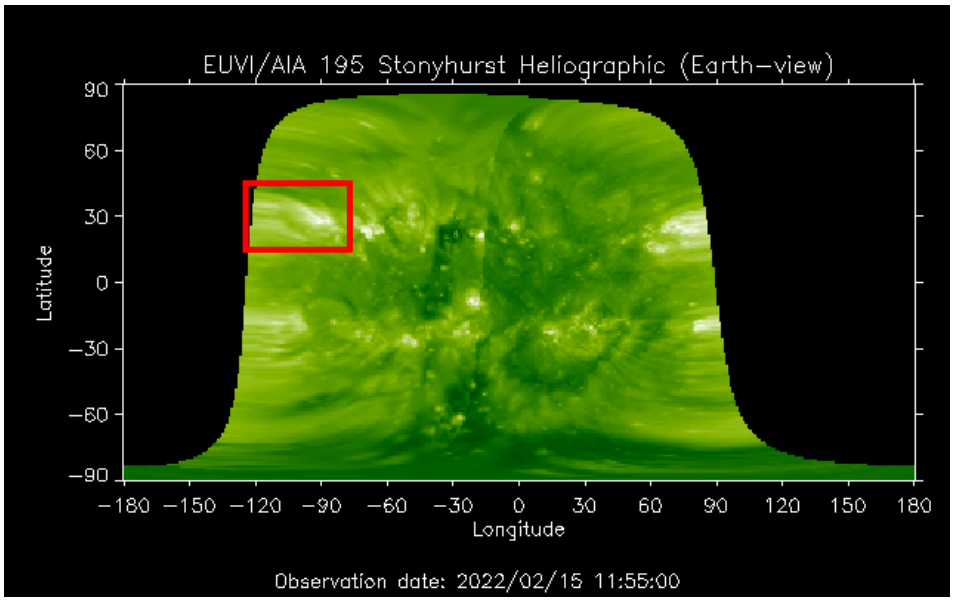
Figure 2: EUVI/AIA 195 images shows bright flux region around the east limb, which are about to rotate onto the visible disc.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels.
Solar radiation storms are not expected in the period, however there is a very slight chance for proton fluxes to rise given any significant flaring from regions close to the western limb, mainly up to day 2 (16 Feb) while AR2941 remains on the front side.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Earth remains under the influence of CH53/-, with high energy electrons now having responded by rising to a mostly High flux diurnal oscillation. In the absence of any further impetus in the four-day period, current levels should be maintained initially, but with increasing uncertainty with time and perhaps a gradual decline.
Current levels are proving similar to the last rotation, where the Active 24-hour integrated fluence threshold was marginally exceeded each day. This gives us greater than usual confidence that Active fluence levels are expected in the four-day period, with REFM likely providing a good guide to fluence trends.

GEO Electron Environment	Level (cm^{-2} sr^{-1}	Past 24 Hours	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)

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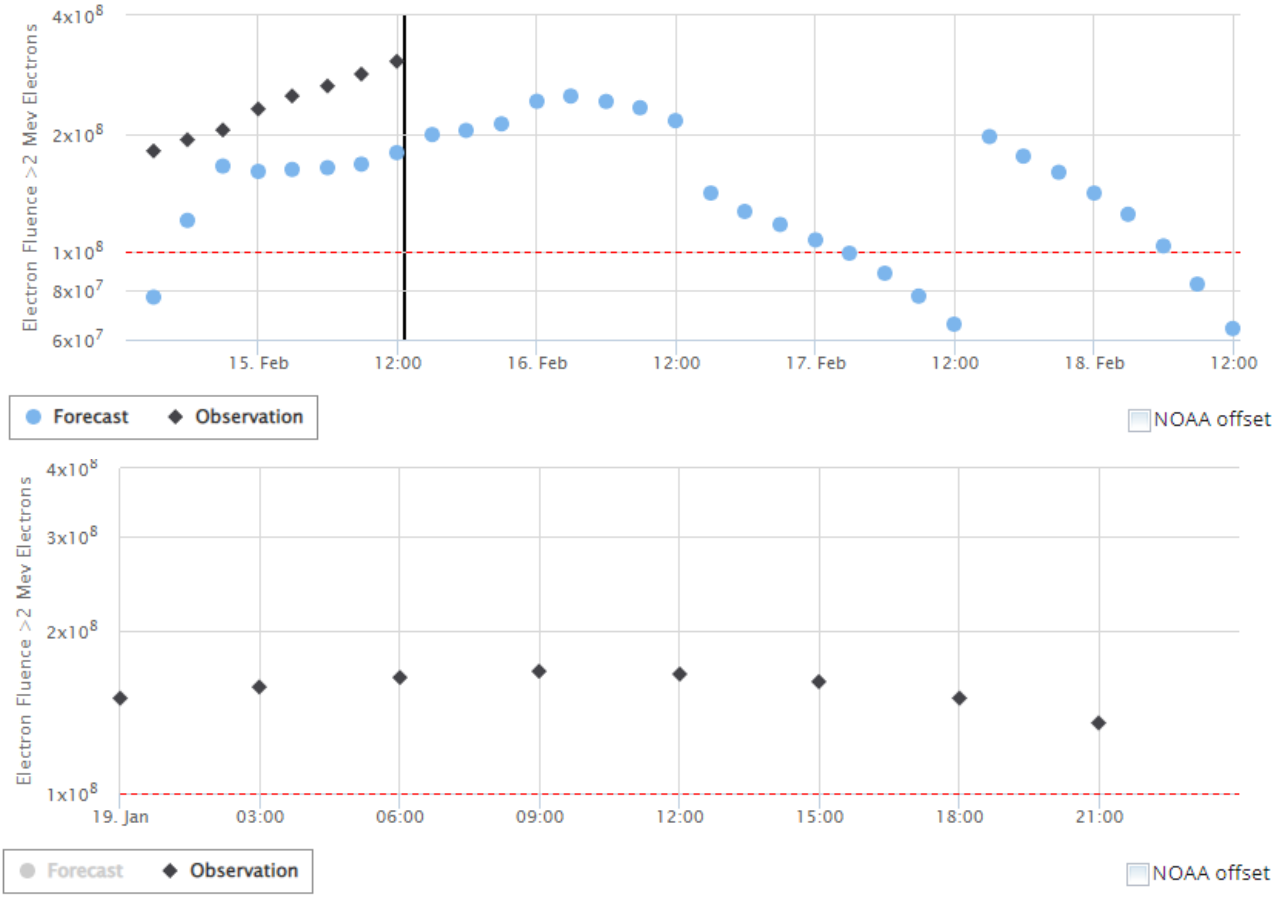
Probability (Exceedance)	day^{-1})	(Yes/No)	(%)	(%)	(%)	(%)
Active	**≥ 2 MeV ≥ 1x10^{8}**	Yes	100	80	70	60
Very Active	**≥ 2 MeV ≥ 1x10^{9}**	No	1	1	1	1

Figure 3: REFM electron fluence observations and forecast (top) – shows a similar response to previous rotation 27 days ago, given a similar magnitude coronal hole (bottom).



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